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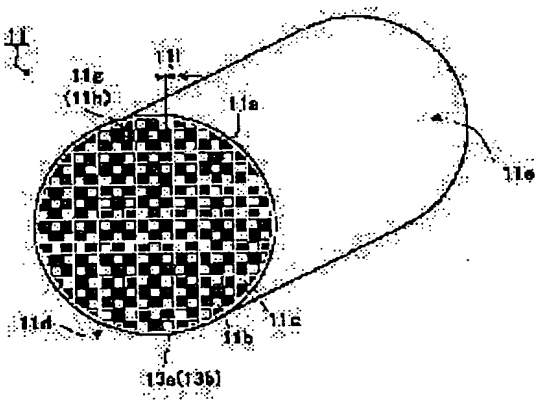
(54) POROUS CERAMIC HONEYCOMB STRUCTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a honeycomb structure which is not of a complicated structure and is easily manufactured and further captures fine particles contained in an exhaust gas with high efficiency and also cuts a pressure loss to a low level.
SOLUTION: This porous ceramic honeycomb structure comprises an outer peripheral wall and numerous cells surrounded by a cell wall on the inner peripheral side of the outer peripheral wall. Both edge faces of the exhaust gas inflow side and the exhaust gas outflow side of the cells are alternately sealed and the exhaust gas is made to flow into the adjacent cells by allowing the exhaust gas to pass through the pores of the cell wall. Thus fine particles contained in the exhaust gas are captured by the cell wall. In addition, the structure has a section of a square shape surrounded by the cell wall whose thickness is 0.1 to 0.3 mm, with a cell pitch of 1.4 to 3 mm. Besides the sectional area surrounded by the cell wall is 1.3 mm2 or more, or the inside dimension between both internal faces of the cell wall is 1.15 mm or more. Further, the surface of a filter per unit volume is 7 cm2/cm3 or more, preferably 10 cm2/cm3 or more and the porosity of the cell wall is 50 to 70%.



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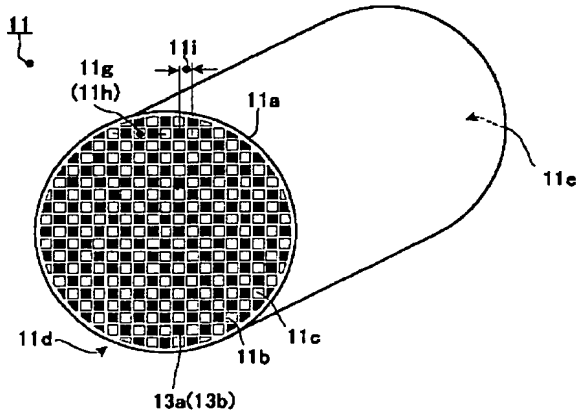
(54)【発明の名称】　多孔質セラミックハニカム構造体

(57)【要約】
【課題】　構造が複雑でなく、製造が容易で、且つ、排気ガスに含まれる微粒子を高効率に捕集すると共に圧力損失を低くできるハニカム構造体を得る。
【解決手段】　外周壁と、この外周壁の内周側でセル壁により囲まれた無数のセルを有し、セルの排気ガス流入側及び排気ガス流出側の両端面を交互に目封じして、排気ガスをセル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子をセル壁で捕集する多孔質セラミックハニカム構造体であって、セル壁で囲まれる断面が四角形状を有し、セル壁厚が０．１～０．３ｍｍ、セルピッチが１．４～３ｍｍで、セル壁で囲まれる断面積を１．３ｍｍ² 以上又はセル壁間の内寸を１．１５ｍｍ以上、単位体積あたりのフィルタ表面積を７ｃｍ²／ｃｍ³以上、好ましくは単位体積あたりのフィルタ表面積を１０ｃｍ²／ｃｍ³以上、セル壁の気孔率を５０～７０％とする。



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【特許請求の範囲】

【請求項１】　外周壁と、この外周壁の内周側でセル壁により囲まれた無数のセルを有し、セルの排気ガス流入側及び排気ガス流出側の両端面を交互に目封じして、排気ガスをセル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子をセル壁で捕集する多孔質セラミックハニカム構造体であって、セル壁で囲まれる断面が四角形状を有し、セル壁厚が０．１～０．３ｍｍ、セルピッチが１．４～３ｍｍで、セル壁で囲まれる断面積を１．３ｍｍ^{2}以上又はセル壁間の内寸を１．１５ｍｍ以上、単位体積あたりのフィルタ表面積を７ｃｍ^2／ｃｍ^{3}以上としていることを特徴とする多孔質セラミックハニカム構造体。

【請求項２】　前記単位体積あたりのフィルタ表面積を１０ｃｍ^2／ｃｍ^{3}以上としていることを特徴とする請求項１に記載の多孔質セラミックハニカム構造体。

【請求項３】　前記セル壁の気孔率を５０～７０％としていることを特徴とする請求項１又は請求項２に記載の多孔質セラミックハニカム構造体。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、例えば、ディーゼルエンジンから排出される排気ガス中の微粒子を捕集する多孔質セラミックハニカム構造体に関する。

【０００２】

【従来技術】地域環境や地球環境の保全面から、自動車などのエンジンから排出される排気ガスに含まれる有害物質の削減が求められ、これに応えるため排気ガス浄化用の触媒コンバータが用いられている。この触媒コンバータのひとつにセラミックハニカム触媒コンバータがある。また、最近はディーゼルエンジンからの排気ガス中に含まれる微粒子を捕集するために、多孔質セラミックハニカム構造体（以下、「多孔質セラミックハニカム構造体」を略して「ハニカム構造体」という）で、セルの排気ガス流入側及び排気ガス流出側の両端面を交互に目封じした排気ガス浄化フィルタが使用されてきている。

【０００３】図１はハニカム構造体１１の斜視図であり、図２は、図１のハニカム構造体１１の断面模式図である。図１及び図２に示すように、通常、ハニカム構造体１１は略円筒状で、外周壁１１ａと、この外周壁１１ａの内周側でセル壁１１ｂにより囲まれた無数のセル１１ｃを有し、セル１１ｃの流入側端面１１ｄ、流出側端面１１ｅの両端面を交互に封止材１３ａ、１３ｂで目封じされている。そしてハニカム構造体１１は、その外周壁１１ａを把持部材（図示せず）で把持して収納容器（図示せず）内に収納され排気ガス浄化フィルタとしている。また排気ガス浄化フィルタは、例えば自動車の排気マニホルドの後などに配置されている。

【０００４】排気ガス浄化フィルタでの排気ガス浄化は、以下の通り行われる。図２で、排気ガスは、ハニカム構造体１１の流入側端面１１ｄで開口しているセル１１ｃから流入（１０ａで示す）し、セル壁１１ｂに形成された細孔（図示せず）を通過した後、流出側端面１１ｅから排出（１０ｂで示す）される。そして、排気ガス中に含まれる微粒子などは、セル壁１１ｂ内で連続する細孔から隣接セルに通過する際に濾過され、捕集される。

【０００５】しかし、捕集される微粒子の量が多くなると細孔が微粒子によって詰まり、エンジンに用いた場合に背圧が増加してエンジン出力を低下させる。このため、捕集された微粒子が一定量を超えたときに微粒子を除去することで背圧増加を抑える必要がある。微粒子は、固定炭素成分と有機溶剤に溶解可能で可燃性の可溶性有機成分であるので、約６５０℃以上の温度に加熱すれば燃焼する。そこで、電気ヒータ、バーナ、熱風などの加熱手段を用いて微粒子を再燃焼させて、排気ガス浄化フィルタを再生している。又、触媒を使用して低温で連続的に微粒子を再生する方法もとられている。

【０００６】この排気ガス浄化フィルタの特性で重要なことは、一定以下の圧力損失で、エンジンの背圧増加を抑えつつ捕集が継続できる時間、即ち捕集時間が長いことである。捕集時間が短いと再生までのインターバルが短くなり、必然的に排気ガス浄化フィルタの容積を大きくしなければならなくなる。

【０００７】これに対して従来技術には、排気ガスの流入側と流出側のセルの開口率やセルの流路方向の断面積を調整して圧力損失を少なくしようとしたハニカムフィルタの開示がある。即ち、特開平５－６８８２８号公報には、排気ガス浄化装置のハニカムフィルタにおいて、排気ガス流入側の開口率が６０～７０％のとき流出側の開口率を２０～３０％、流入側に開口する各セルのセルピッチを２．５～５．０ｍｍに設定することで、排気ガスがフィルタを通過する際の圧力損失を低く、またセル中に排気ガスを容易に導入できるとしている。また、この特開平５－６８８２８号公報には、排気ガス流入側に開口する各セルは断面六角形状の中空部を有すると共に、排気ガス流出側に開口する各セルは断面三角形状の中空部とする記載がある。

【０００８】また別の特開平１０－５７７３０号公報には、外周壁と、この外周壁と一体にかつ外周壁内にハニカム状に形成された貫通孔隔壁と、貫通孔隔壁により仕切られた複数の貫通孔と、貫通孔の一端部のみに形成された封止体と、を備えたセラミックハニカムフィルタであって、封止体はセラミックハニカムフィルタの両端面において略市松模様状に形成されていると共に、貫通孔の封止体形成部の断面積を、封止体非形成部の断面積よりも小さく、好ましくは封止体形成部の断面積を封止体非形成部の断面積に対し２０％～５０％にすることで、排ガスの流入時及び流出時における圧力損失を低減できるとする記載がある。

【０００９】また、特開平７－１６３８２２号公報には、気孔率３０％以上のコージェライト粉末を骨材とし、これにコージェライト化原料粉末、造孔剤、成形助剤等を加えて、混練、成形、焼成を行って得た、フィルタの平均細孔径が骨材の平均径×０．１５±５μｍ以内、気孔率が３０％以上であるコージェライト質セラミックフィルタによって、捕集効率が高く、圧力損失が小さく、軽量且つコンパクトで自動車に搭載可能な強度を有するフィルタが提供できるとする記載がある。

【００１０】

【発明が解決しようとする課題】しかしながら、前記特開平５－６８８２８号公報に記載のハニカムフィルタは、排気ガス流入側と流出側の開口率を異ならせて所定範囲としているが、排気ガス流入側と流出側で開口率を制御することは難しく、構造も複雑となる。また、各セルの断面を、排気ガスの流入側を六角形状、流出側を三角形状とするのは、坏土からハニカムフィルタ素材を成形する際の押出用金型の構造も複雑となる。

【００１１】また、特開平１０－５７７３０号公報に記載のセラミックハニカムフィルタは、貫通孔の封止体形成部の断面積と封止体非形成部の断面積を異ならせて所定範囲としているが、貫通孔の断面積を異ならせ制御することは難しく、構造も複雑となる。また、貫通孔の封止体非形成部の断面積を拡張変更する工程が増加する。

【００１２】特開平７－１６３８２２号公報に記載のコージェライト質セラミックフィルタは、気孔率３０％以上のコージェライト骨材を使用していることから、その細孔構造は径の大きなコージェライト化原料による細孔と、径の小さな連鎖孔からなる。そのため、その強度特性を確保するために、流路隔壁の厚さが３００～２０００μｍ必要なため、流入側と流出側の差圧が大きくなり、圧力損失が大きくなるという問題がある。

【００１３】また近年、ハニカム構造体のセル壁や細孔に白金族金属触媒などの触媒を担持することで、排気ガス中の微粒子を捕集すると共に、排気ガス中に含まれる窒素酸化物など有害物質を浄化することも行われてきている。しかし、流路隔壁の厚さが３００～２０００μｍある場合は、ハニカム構造体の熱容量が大きくなるため、エンジン始動直後から触媒が活性化されるまでの時間が長くなり、その間、有害物質が排出されてしまうという問題もある。

【００１４】従って、本発明の課題は、構造が複雑でなく、製造が容易で、且つ、排気ガスに含まれる微粒子を高効率に捕集すると共に、圧力損失を低くできるハニカム構造体を得ることにある。更に、触媒を担持しても、排気ガスに含まれる微粒子を高効率に捕集すると共に圧力損失を低くできるハニカム構造体を得ることにある。

【００１５】

【課題を解決するための手段】本発明者らは、上記課題に鑑み鋭意研究した。その結果、セル壁で囲まれる断面を四角形状とし、セル壁厚、セルピッチ、セル壁で囲まれる断面積又はセル壁間の内寸、単位体積あたりのフィルタ表面積、又は更にセル壁の気孔率を適切に選択すれば、構造が複雑でなく、製造が容易で、且つ、排気ガスに含まれる微粒子を高効率に捕集すると共に圧力損失を低くできるハニカム構造体が得られ、更に触媒を担持しても、排気ガスに含まれる微粒子を高効率に捕集すると共に、圧力損失を低くできるハニカム構造体が得られるとの知見を得、本発明に想到した。

【００１６】即ち、本発明のハニカム構造体は、外周壁と、この外周壁の内周側でセル壁により囲まれた無数のセルを有し、セルの排気ガス流入側及び排気ガス流出側の両端面を交互に目封じして、排気ガスをセル壁の細孔を通過させて隣接セルに流し、排気ガスに含まれる微粒子をセル壁で捕集する多孔質セラミックハニカム構造体であって、前記セル壁で囲まれる断面が四角形状を有し、セル壁厚が０．１～０．３ｍｍ、セルピッチが１．４～３ｍｍで、セル壁で囲まれる断面積を１．３ｍｍ^{2}以上又はセル壁間の内寸を１．１５ｍｍ以上、単位体積あたりのフィルタ表面積を７ｃｍ^2／ｃｍ^{3}以上としていることを特徴とする。

【００１７】本発明においては、前記単位体積あたりのフィルタ表面積を１０ｃｍ^2／ｃｍ^{3}以上としていることが好ましい。更に、本発明においては、前記セル壁の気孔率を５０～７０％としていることが好ましい。

【００１８】次に、本発明での構成の理由を説明する。（セル壁で囲まれる断面の形状）セル壁で囲まれる断面を四角形状とすれば、構造が複雑でなく、製造が容易なハニカム構造体となる。また坏土からハニカム構造の成形体とする際の押出用金型も、構造が複雑でないため製作が容易である。なお、四角形状は一辺の長さが２０％近く異なる略四角形状も含むものとする。

【００１９】（セル壁厚）セル壁厚が０．１ｍｍ未満では、坏土からハニカム構造の成形体とするのに用いる押出用金型の坏土排出通路が細すぎて坏土が排出されにくく生産性が低下する。一方、セル壁厚が０．３ｍｍを超えると、流入側と流出側の差圧が大きくなり、圧力損失が大きくなる。従って、セル壁厚を０．１～０．３ｍｍとする。

【００２０】（セルピッチ）セルピッチが１．４ｍｍ未満では、排気ガスがセル１１ｃの流入側１１ｄに入る際の抵抗が大きくなる。一方、セルピッチが３ｍｍを超えると、単位断面積当たりのセル数が減ることから単位体積当たりのフィルタ表面積が小さくなるため、圧力損失が大きくなるためである。従って、セルピッチを１．４～３ｍｍとする。

【００２１】（セル壁で囲まれる断面積又はセル壁間の内寸）セル壁で囲まれる断面積が１．３ｍｍ^{2}未満又はセル壁間の内寸が１．１５ｍｍ未満であると、フィルタ表面積との関係で排気ガスがセル１１ｃの流入側１１ｄ

に入る際の抵抗が大きくなる。なお、セル壁で囲まれる断面積は、一つのセルの流路方向の断面積を示す。

【００２２】（単位体積あたりのフィルタ表面積）フィルタ表面積とは、排気ガスが通過するセルの幾何学的表面積をいい、

単位体積あたりのフィルタ表面積＝セル壁間の内寸×４÷（セルピッチ）^{2} ×１／２

で表される。ハニカム構造体において単位体積あたりのフィルタ表面積が７ｃｍ^2／ｃｍ^{3}未満であると、セル壁で囲まれる断面積又はセル壁の内寸との関係で排気ガスが通過時の圧力損失が大きくなる。従って、単位体積あたりのフィルタ表面積を７ｃｍ^2／ｃｍ^{3}以上、好ましくは、単位体積あたりのフィルタ表面積を１０ｃｍ^2／ｃｍ^{3}以上とする。

【００２３】（気孔率）セル壁の気孔率が５０％未満であると、セル壁で囲まれる断面積又はセル壁の内寸、単位体積あたりのフィルタ表面積との関係で排気ガスが通過時の圧力損失が大きくなる。また、セル壁や細孔に白金族金属触媒など触媒を担持する場合には触媒の担持が難しくなる。一方、気孔率が７０％を超えると、強度が低下するのと微粒子の捕集効率が低下する。従って、気孔率は５０～７０％とする。なお気孔率は、水銀圧入式ポロシメータを用いて測定する。

【００２４】

【発明の実施の形態】以下、発明の実施の形態を詳細に説明する。

【００２５】図１及び図２に示すハニカム構造体１１を以下のようにして作製した。

（基本原料粉末の調整）カオリン、タルク、シリカ、水酸化アルミ、アルミナなどの粉末を計量して、化学組成が質量比で、SiO_2：４７～５３％、Al_2O_3：３２～３８％、ＭｇＯ：１２～１６％となるコーディエライト質セラミックス原料粉末を調整した。該セラミックス原料粉末は他に不可避的に混入する成分例えば、ＣａＯ、Na_2O、K_2O、TiO_2、Fe_2O_3、ＰｂＯ、P_2O_5を全体として２．５質量%以下含んでいる。

【００２６】（成形助剤及び造孔剤の添加と、坏土の精製）次に、このコーディエライト質セラミックの原料粉末に対し、成形助剤としてメチルセルロースとヒドロキシプロピルメチルセルロース、造孔剤として、グラファイト、小麦粉、でん粉などを適宜選定して添加し、乾式で十分混合した。次いで、規定量の水を注入して更に十分な混合を行い、押出成形可能な坏土を作製した。

＊【００２７】（押出成形）次に、一般的な構造の押出成形用金型を用い押出成形した。図３で、（ａ）はハニカム構造を有する成形体の部分図、（ｂ）は押出成形用金型の要部断面図である。なお、図３（ａ）で括弧した符号は焼成後のハニカム構造体１１の部位を示す。図３で、押出成形用金型２０は、多数の供給通路２１ａとこの供給通路２１ａから坏土を集合すると共に格子状に形成する排出通路２１ｂを持つダイ２１と、ハニカム構造体１１の外周壁１１aを所定形状に形成するために、坏土流入量の調整をするマスキングプレート２２、坏土の排出量の調節をすると共にハニカム構造体１１の外周壁１１ａの調節を行う押さえ枠２３などからなる。なお、押出成形用金型２０は、下から上が押出方向（矢印で示す）であり、坏土を供給通路２１ａから排出通路２１ｂに押し出している。そして、押出成形用金型２０で、セル壁で囲まれる断面が四角形状を有し、セル壁厚１１ｔ、セルピッチ１１ｉ、セル壁で囲まれる断面積１１ｇ及びセル壁間の内寸１１ｈ、単位体積あたりのフィルタ表面積を変えた、ハニカム構造を有する成形体を作製した。

【００２８】（焼成）次に、このハニカム構造を有する成形体を、バッチ式焼成炉を用いて焼成を行った。焼成後、外周壁１１ａの外径が１５０ｍｍ、長さが１５０ｍｍ、セル壁１１ｂの気孔率が６０％で、セル壁１１ｂで囲まれる断面が四角形状を有し、表１に示すように、セル壁厚１１ｔ、セルピッチ１１ｉ、セル壁で囲まれる断面積１１ｇ又はセル壁間の内寸１１ｉ、単位体積あたりのフィルタ表面積を変えたハニカム構造体１１を得た。

【００２９】（目封じ）次に、ハニカム構造を有する焼成体の流入側端面１１ｄのセル１１ｃを一個おきに封止材１３ａで目封じし、排気ガス流出側端面１１ｅでは流入側端面１１ｄで目封じしてないセル１１ｃについてのみ封止材１３ｂで目封じした。なお、封止材１３ａ、１３ｂはコーディエライト質セラミックを用いた。

【００３０】次に、圧力損失試験装置（図示せず）で、各ハニカム構造体１１に流量７．５Ｎｍ^3／ｍｉｎとして空気を流入し、流入側１１ｄと流出側１１ｅの差圧（ｍｍＡｑ）を測定し、各ハニカム構造体１１の圧力損失を評価した。なお、圧力損失の評価は、差圧が２５０ｍｍＡｑ未満を優（◎）、２５０～３５０ｍｍＡｑを良（○）、３５０ｍｍＡｑを超えるものをＮＧ（×）として行った。その結果を表１に纏めて示す。

【００３１】

（表１）

区分	セル壁厚 (mm)	セルピッチ (mm)	断面積 (mm^2)	内寸 (mm)	フィルタ表面積 (cm^2/cm^3)	差圧 (mmAq)	圧力損失の評価
発明例1	0.30	1.80	2.25	1.50	9.3	266	○
発明例2	0.30	1.47	1.37	1.17	10.8	249	◎
発明例3	0.25	1.47	1.49	1.22	11.3	238	◎
発明例4	0.23	1.51	1.64	1.31	11.0	233	◎

比較例1	0.43	2.54	4.45	2.11	6.5	414	×
比較例2	0.15	1.27	1.25	1.12	13.9	452	×
比較例3	0.30	3.00	7.29	2.70	6.0	368	×
比較例4	0.30	1.27	0.94	0.97	12.0	425	×
比較例5	0.30	3.50	10.24	3.20	5.2	371	×

（注）表１で、断面積はセル壁で囲まれる断面積１１ｇを、内寸はセル壁間の内寸１１ｈを、フィルタ表面積は単位体積あたりのフィルタ表面積をそれぞれ略して示す。

【００３２】表１から、発明例１～４は、セル壁厚１１ｃが０．１～０．３ｍｍ、またセルピッチ１１ｉが１．４～３ｍｍ、セル壁で囲まれる断面積１１ｇが１．３ｍｍ²以上又はセル壁間の内寸１１ｈが１．１５ｍｍ以上、単位体積あたりのフィルタ表面積が７ｃｍ²／ｃｍ³、好ましくは１０ｃｍ²／ｃｍ³以上であるので、差圧が小さくて圧力損失の少ないハニカム構造体１１となっていることがわかる。

【００３３】一方、比較例１は、セル壁で囲まれる断面積１１ｇが１．３ｍｍ² 以上又はセル壁間の内寸１１ｉが１．１５ｍｍ以上であるが、セル壁厚が０．３ｍｍを越えているため、単位体積あたりのフィルタ表面積が７ｃｍ²／ｃｍ³未満であり、差圧が大きく、圧力損失が大きいことがわかる。比較例２、４は、単位体積あたりのフィルタ表面積が７ｃｍ²／ｃｍ³以上ではあるが、セル壁で囲まれる断面積１１ｇが１．３ｍｍ² 未満又はセル壁間の内寸１１ｈが１．１５ｍｍ未満であり、またセルピッチ１１ｉが１．４未満であり、差圧が大きく、圧力損失が大きいことがわかる。比較例３は、セル壁で囲まれる断面積１１ｇが１．３ｍｍ² 以上又はセル壁間の内寸１１ｉが１．１５ｍｍ以上であるが、単位体積あたりのフィルタ表面積が７ｃｍ²／ｃｍ³未満であり、差圧が大きく、圧力損失が大きいことがわかる。比較例５は、セル壁で囲まれる断面積１１ｇが１．３ｍｍ² 以上又はセル壁間の内寸１１ｉが１．１５ｍｍ以上であるが、セルピッチが３ｍｍを超え、単位体積あたりのフィルタ表面積が７ｃｍ²／ｃｍ³未満であるので、差圧が大きく、圧力損失が大きいことがわかる。

【００３４】（触媒担持）発明例１～４のハニカム構造体１１は、必要に応じて、セル壁１１ｂ及び細孔内に触媒を担持する。ハニカム構造体１１に白金族金属触媒を担持した場合には、捕集したカーボンが排気ガス成分中のＮＯｘの触媒反応によって形成されるNO_2との化学反応により連続的に低温で燃焼されることから、燃焼温度は電気ヒーターやバーナなどで燃焼させる場合に比べ低下させることでハニカム構造体を溶損させることなく、連続的に再生することが出来る。

【００３５】

【発明の効果】以上詳細に説明のとおり、本発明のハニカム構造体によれば、構造が複雑でなく、製造が容易となり、且つ、排気ガスに含まれる微粒子を高効率に捕集すると共に圧力損失を低くできる。

【図面の簡単な説明】

【図１】ハニカム構造体の斜視図である。

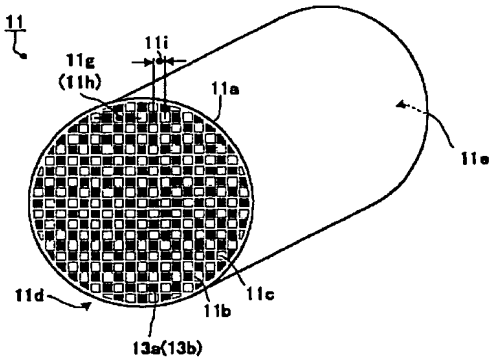
【図２】図１のハニカム構造体を用いた排気ガス浄化フィルタ１０の一例の断面模式図である。

【図３】（ａ）はハニカム構造を有する成形体の部分部、（ｂ）は押出成形用金型の要部断面図である。

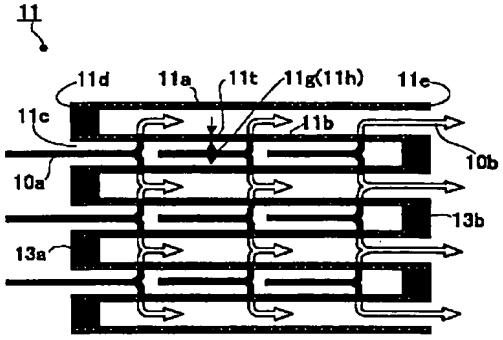
【符号の説明】

１０ａ：流入
１０ｂ：流出
１１：ハニカム構造体
１１ａ：外周壁
１１ｂ：セル壁
１１ｃ：セル
１１ｄ：流入側端面
１１ｅ：流出側端面
１１ｆ：流入側端面
１１ｇ：セル壁で囲まれる断面積
１１ｈ：セル壁間の内寸
１１ｉ：セルピッチ
１１ｔ：セル壁厚
１３ａ，１３ｂ：封止材
２０：押出成形用金型
２１：ダイ
２１ａ：供給通路
２１ｂ：排出通路
２２：マスキングプレート
２３：押さえ枠

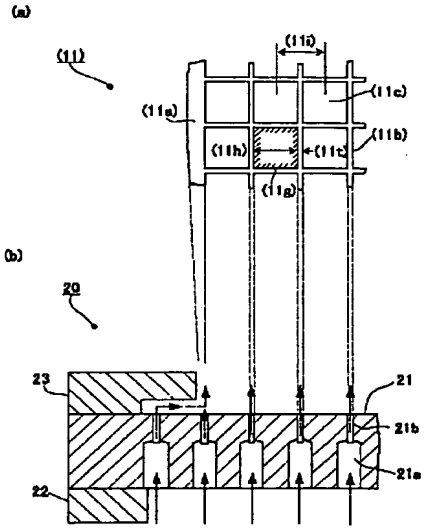
【図１】



【図２】



【図３】



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Have the countless cel surrounded with the cell wall by the inner circumference side of a peripheral wall and this peripheral wall, and the both-ends side by the side of the exhaust gas inflow of a cel and an exhaust gas outflow is ******(ed) by turns. It is the porosity ceramic honeycomb structure object which carries out uptake of the particle which is made to pass the pore of a cell wall and is contained in a contiguity cel in exhaust gas at a sink and exhaust gas with a cell wall. The cross section surrounded with a cell wall has the shape of a square. 0.1-0.3mm and a cel pitch by 1.4-3mm [cell wall thickness] It is the cross section surrounded with a cell wall 1.3mm 2 Porosity ceramic honeycomb structure object characterized by setting 1.15mm or more and filter surface area per unit volume to three or more 7cm2/cm for the inside dimension between the above or a cell wall.
[Claim 2] The porosity ceramic honeycomb structure object according to claim 1 characterized by setting filter surface area per said unit volume to three or more 10cm2/cm.
[Claim 3] The porosity ceramic honeycomb structure object according to claim 1 or 2 characterized by making the porosity of said cell wall into 50 - 70%.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the porosity ceramic honeycomb structure object which carries out uptake of the particle in the exhaust gas discharged from a diesel power plant.
[0002]
[Description of the Prior Art] In order to call for reduction of the harmful matter contained in the exhaust gas discharged from engines, such as an automobile, and to respond to this from the maintenance side of a local environment or earth environment, the catalytic converter for exhaust gas purification is used. A ceramic honeycomb catalyst converter is in one of the catalytic converter of this. Moreover, in order to carry out uptake of the particle contained in the exhaust gas from a diesel power plant recently, the exhaust gas purification filter which is a porosity ceramic honeycomb structure object (henceforth [a "porosity ceramic honeycomb structure object" is omitted and] a "honeycomb structure object"), and ******(ed) the both-ends side by the side of the exhaust gas inflow of a cel and an exhaust gas outflow by turns has been used.
[0003] Drawing 1 is the perspective view of the honeycomb structure object 11, and drawing 2 is the cross section of the honeycomb structure object 11 of drawing 1 . As shown in drawing 1 and drawing 2 , the honeycomb structure object 11 is usually approximately cylindrical, and it has countless cel 11c surrounded by cell wall 11b by the inner circumference side of peripheral-wall 11a and this peripheral-wall 11a, and is **** suggestion ******** with sealing agents 13a and 13b by turns about 11d of inflow side edge sides of cel 11c, and the both-ends side of outflow side edge side 11e. And the honeycomb structure object 11 grasps the peripheral-wall 11a by the grasping member (not shown), is contained in a stowage container (not shown), and is used as the exhaust gas purification filter. Moreover, the exhaust gas purification filter is arranged after the exhaust manifold of an automobile etc.
[0004] Exhaust gas purification with an exhaust gas purification filter is performed as follows. By drawing 2 , exhaust gas flows from cel 11c which is carrying out opening 11d in respect of the inflow side edge of the honeycomb structure object 11 (10a shows), and after it passes the pore (not shown) formed in cell wall 11b, it is discharged from outflow side edge side 11e (10b shows). And in case the particle contained in exhaust gas passes in a contiguity cel from the pore which continues within cell wall 11b, it is filtered, and uptake is carried out.
[0005] However, when the amount of the particle by which uptake is carried out increased, and pore is got blocked by the particle and uses for an engine, back pressure increases and engine power is reduced. For this reason, when the particle by which uptake was carried out exceeds a constant rate, it is necessary to suppress the increment in back pressure by removing a particle. Since a particle is the fusibility organic component of that it can dissolve in a fixed-carbon component and an organic solvent, and inflammability, if it heats in temperature of about 650 degrees C or more, it will burn. Then, a particle is made to afterburn using heating means, such as an electric heater, a burner, and hot blast, and the exhaust gas purification filter is reproduced. Moreover, the approach of reproducing a particle continuously at low temperature using a catalyst is also taken.
[0006] An important thing is the pressure loss below fixed in the property of this exhaust gas purification filter, and the time amount which can continue uptake, i.e., uptake time amount, is a ********, suppressing the engine increment in back pressure. If uptake time amount is short, the interval to playback becomes short and must enlarge the volume of an exhaust gas purification filter inevitably.
[0007] On the other hand, the conventional technique has the indication of the honeycomb filter which was going to adjust the numerical aperture of the cel by the side of the inflow of exhaust gas, and an outflow, and the cross section of the direction of passage of a cel, and was going to lessen pressure loss. That is, in the honeycomb filter of an exhaust gas purge, it is supposed that it is low in the pressure loss at the time of exhaust gas passing a filter, and exhaust gas can be easily introduced into a cel by setting the cel pitch of each cel which carries out opening of the numerical aperture by the side of an outflow to an inflow side 20 to 30% as 2.5-5.0mm when the numerical aperture by the side of an exhaust gas inflow is 60 - 70% at JP,5-68828,A. Moreover, while each cel which carries out opening to an exhaust gas inflow side has a cross-section hexagon-like centrum, each cel which carries out opening to an exhaust gas outflow side has the publication made into a cross-section triangle-like centrum in this JP,5-68828,A.
[0008] moreover, in another JP,10-57730,A To a peripheral wall, this peripheral wall, and one, and the through tube septum formed in periphery Kabeuchi in the shape of a honeycomb, Two or more through tubes divided by the through tube septum, and the closure object formed only in the end section of a through tube, While being a ******** ceramic honeycomb filter and forming the closure object in the shape of an abbreviation checker in the both-ends side of a ceramic honeycomb filter In the cross section of the closure object formation section of a through tube, it is smaller than the cross section of the closure object agenesis section, and is making the cross section of the closure object formation section preferably 20% - 50% to the cross section of the closure object agenesis section, and there is a publication to which it is supposed that the pressure loss at the time of the inflow of exhaust gas and an outflow can be reduced.
[0009] Moreover, the cordierite powder of 30% or more of porosity is used as the aggregate at JP,7-163822,A. To this cordierite-ized raw material powder, an ostomy agent, a shaping assistant, etc. In addition, kneading, With the nature ceramic filter of cordierite whose porosity the average pore size of a filter which obtained by performing shaping and baking is less than [of the aggregate / pitch-diameter x0.15**5micrometer], and is 30% or more There is a publication to which it is supposed that collection efficiency is high, pressure loss is small, and the filter which has the reinforcement which can be carried [that it is lightweight and compact and] in an automobile can be offered.
[0010]
[Problem(s) to be Solved by the Invention] However, although a honeycomb filter given in said JP,5-68828,A changes the numerical aperture by the side of an exhaust gas inflow and an outflow and is made into the predetermined range, it is an exhaust gas inflow and outflow side, and it is difficult to control a numerical aperture and it becomes complicated [structure]. moreover, the extrusion at the

time of making the inflow side of exhaust gas into the shape of a hexagon, and making an outflow side into the shape of a triangle for the cross section of each cel fabricating a honeycomb filter material from a plastic matter -- public funds -- the structure of a mold also becomes complicated.

[0011] Moreover, although a ceramic honeycomb filter given in JP,10-57730,A changes the cross section of the closure object formation section of a through tube, and the cross section of the closure object agenesis section and is made into the predetermined range, it is difficult to change the cross section of a through tube and to control, and it becomes complicated [structure]. Moreover, the process which makes an extended change of the cross section of the closure object agenesis section of a through tube increases.

[0012] Since the nature ceramic filter of cordierite of a publication is using the cordierite aggregate of 30% or more of porosity for JP,7-163822,A, the pore structure consists of pore by the big cordierite-ized raw material of a path, and a small chain hole of a path. Therefore, in order to secure the strength property, since 300-2000 micrometers of thickness of a passage septum are required, there is a problem that the differential pressure by the side of an inflow and an outflow becomes large, and pressure loss becomes large.

[0013] Moreover, while carrying out uptake of the particle in exhaust gas to the cell wall and pore of a honeycomb structure object by supporting catalysts, such as a platinum metal catalyst, in recent years, purifying harmful matter, such as nitrogen oxides contained in exhaust gas, has also been performed. However, since the heat capacity of a honeycomb structure object becomes large when there are 300-2000 micrometers of thickness of a passage septum, time amount until a catalyst is activated from immediately after engine starting becomes long, and there is also a problem that harmful matter will be discharged in the meantime.

[0014] Therefore, it is to acquire the honeycomb structure object which can make pressure loss low while the technical problem of this invention does not have complicated structure, and is easy to manufacture and carries out uptake of the particle contained in exhaust gas efficient. Furthermore, even if it supports a catalyst, while carrying out uptake of the particle contained in exhaust gas efficient, it is in acquiring the honeycomb structure object which can make pressure loss low.

[0015]

[Means for Solving the Problem] this invention persons inquired wholeheartedly in view of the above-mentioned technical problem. consequently, the cross section which makes the cross section surrounded with a cell wall the shape of a square, and is surrounded with cell wall thickness, a cel pitch, and a cell wall or the inside dimension between cell walls, and the filter surface area per unit volume -- or, if the porosity of a cell wall is chosen further appropriately While structure is not complicated, and manufacture is easy and carrying out uptake of the particle contained in exhaust gas efficient, even if the honeycomb structure object which can make pressure loss low is acquired and it supports a catalyst further, while carrying out uptake of the particle contained in exhaust gas efficient Knowledge that the honeycomb structure object which can make pressure loss low is acquired was acquired, and it hit on an idea to this invention.

[0016] Namely, the honeycomb structure object of this invention has the countless cel surrounded with the cell wall by the inner circumference side of a peripheral wall and this peripheral wall, and ****** the both-ends side by the side of the exhaust gas inflow of a cel, and an exhaust gas outflow by turns. It is the porosity ceramic honeycomb structure object which carries out uptake of the particle which is made to pass the pore of a cell wall and is contained in a contiguity cel in exhaust gas at a sink and exhaust gas with a cell wall. The cross section surrounded with said cell wall has the shape of a square. 0.1-0.3mm and a cel pitch by 1.4-3mm [cell wall thickness] It is the cross section surrounded with a cell wall 1.3mm 2 It is characterized by setting 1.15mm or more and filter surface area per unit volume to three or more 7cm2/cm for the inside dimension between the above or a cell wall.

[0017] In this invention, it is desirable to set filter surface area per said unit volume to three or more 10cm2/cm. Furthermore, in this invention, it is desirable to make the porosity of said cell wall into 50 - 70%.

[0018] Next, the reason of the configuration from this invention is explained.

(Configuration of the cross section surrounded with a cell wall) In the cross section surrounded with a cell wall, the shape of a square then and structure are not complicated, and serve as a honeycomb structure object with easy manufacture. moreover, the extrusion at the time of considering as the Plastic solid of honeycomb structure from a plastic matter -- public funds -- since structure of a mold is not complicated, it is easy to manufacture. In addition, the shape of a square shall also include the shape of an abbreviation square from which die length of one side differs about 20%.

[0019] (Cell wall thickness) the extrusion which cell wall thickness uses for considering as the Plastic solid of honeycomb structure from a plastic matter in less than 0.1mm -- public funds -- productivity falls that the plastic matter discharge path of a mold is too thin, and a plastic matter is hard to be discharged. On the other hand, if cell wall thickness exceeds 0.3mm, the differential pressure by the side of an inflow and an outflow will become large, and pressure loss will become large. Therefore, cell wall thickness is set to 0.1-0.3mm.

[0020] (Cel pitch) The resistance at the time of exhaust gas going [a cel pitch] into 11d the inflow side of cel 11c by less than 1.4mm becomes large. On the other hand, if a cel pitch exceeds 3mm, since the number of cels per unit cross section becomes fewer and the filter surface area per unit volume will become small, it is because pressure loss becomes large. Therefore, a cel pitch is set to 1.4-3mm.

[0021] (The cross section surrounded with a cell wall, or inside dimension between cell walls) The cross section surrounded with a cell wall is 2 1.3mm. The resistance at the time of exhaust gas going that the inside dimension between the following or a cell wall is less than 1.15mm into 11d the inflow side of cel 11c by relation with filter surface area becomes large. In addition, the cross section surrounded with a cell wall shows the cross section of the direction of passage of one cel.

[0022] (Filter surface area per unit volume) Filter surface area means the geometric surface area of the cel which exhaust gas passes, and it is expressed with inside dimension x4/(cel pitch)2x1/2 between the filter surface area = cell walls per unit volume. The pressure loss at the time of passage becomes [exhaust gas] large by the relation between the cross section surrounded with a cell wall as the filter surface area per unit volume is less than three 7cm2/cm in a honeycomb structure object, or the inside dimension of a cell wall. Therefore, filter surface area per unit volume is preferably set to three or more 10cm2/cm for the filter surface area per unit volume three or more 7cm2/cm.

[0023] (Porosity) The pressure loss at the time of passage becomes [exhaust gas] large by the relation between the cross section surrounded with a cell wall as the porosity of a cell wall is less than 50% or the inside dimension of a cell wall, and the filter surface area per unit volume. Moreover, support of a catalyst becomes difficult in supporting catalysts, such as a platinum metal catalyst, to a cell wall or pore. On the other hand, if porosity exceeds 70%, the collection efficiency of that reinforcement falls and a particle will fall. Therefore, porosity is made into 50 - 70%. In addition, porosity is measured using a mercury press fit type porosimeter.

[0024]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of invention is explained to a detail.

[0025] It is the following, and the honeycomb structure object 11 shown in drawing 1 and drawing 2 was made and produced. (Adjustment of basic-raw-materials powder) Powder, such as a kaolin, talc, a silica, hydroxylation aluminum, and an alumina, is measured, and chemical composition is SiO2 at a mass ratio. : 2O3:32 - 38% of aluminum and the nature of cordierite ceramic raw

material powder used as MgO:12-16% were adjusted 47 to 53%. This ceramic raw material powder contains the component, for example, CaO, mixed in others unescapable, Na2O, K2O, TiO2, Fe2O3, PbO, and P2O5 below 2.5 mass % as a whole.
[0026] (Addition of a shaping assistant and an ostomy agent, and purification of a plastic matter) Next, as a shaping assistant, as methyl cellulose, the hydroxypropyl methylcellulose, and an ostomy agent, graphite, wheat flour, starch, etc. were selected suitably, and it added, and mixed enough by dry type to the raw material powder of this nature ceramic of cordierite. Subsequently, the water of the amount of conventions was poured in, still more sufficient mixing was performed, and the plastic matter in which extrusion molding is possible was produced.
[0027] (Extrusion molding) Next, extrusion molding was carried out using the extrusion molding die of general structure. In drawing 3 , the partial diagrammatic view of the Plastic solid with which (a) has honeycomb structure, and (b) are the important section sectional views of an extrusion molding die. In addition, the sign parenthesized by drawing 3 (a) shows the part of the honeycomb structure object 11 after baking. In order that the metal mold 20 for extrusion molding may form in a predetermined configuration the die 21 with discharge path 21b formed in the shape of a grid, and peripheral-wall 11a of the honeycomb structure object 11 by drawing 3 while gathering a plastic matter from much supply path 21a and this supply path 21a While adjusting the discharge of the masking plate 22 and plastic matter which adjust plastic matter inflow, it consists of a presser-foot frame 23 which adjusts peripheral-wall 11a of the honeycomb structure object 11. In addition, the bottom to a top is the direction of extrusion (an arrow head shows), and the metal mold 20 for extrusion molding has extruded the plastic matter from supply path 21a to discharge path 21b. And with the metal mold 20 for extrusion molding, the cross section surrounded with a cell wall has the shape of a square, and produced the Plastic solid into which the cross section of 11g surrounded with 11t of cell wall thickness, cel pitch 11i, and a cell wall and the inside dimension of 11h between cell walls, and the filter surface area per unit volume were changed and which has honeycomb structure.
[0028] (Baking) Next, the Plastic solid which has this honeycomb structure was calcinated using the batch type firing furnace. The cross section where the outer diameter of peripheral-wall 11a is surrounded at 60% by 150mm after baking, and the porosity of 150mm and cell wall 11b is surrounded for die length by cell wall 11b has the shape of a square, and as shown in Table 1, the honeycomb structure object 11 into which inside dimension 11i between the cross section of 11g surrounded with 11t of cell wall thickness, cel pitch 11i, and a cell wall or a cell wall and the filter surface area per unit volume were changed was acquired.
[0029] (******) Next, cel of 11d of inflow side edge sides of baking object 11c which has honeycomb structure was ******(ed) by sealing agent 13a every piece, and it ******(ed) by sealing agent 13b at exhaust gas outflow side edge side 11e only about cel 11c which is not ******(ing) 11d in respect of an inflow side edge. In addition, sealing agents 13a and 13b used the nature ceramic of cordierite.
[0030] Next, air was flowed into each honeycomb structure object 11 as flow rate of 7.5Nm 3 / min, the differential pressure (mmAq) of 11d and outflow side 11e was measured the inflow side, and the pressure loss testing device (not shown) estimated the pressure loss of each honeycomb structure object 11. In addition, evaluation of pressure loss performed that to which differential pressure exceeds [less than 250 mmAqs] good (O) and 350mmAq for A (O) and 250 - 350mmAq as NG (x). The result is collectively shown in Table 1.
[0031]
(Table 1)
partition Cell wall thickness Cel pitch The cross section inside dimension Filter surface area Differential pressure Pressure loss (mm) (mm) (mm2) (mm) (cm2/cm3) (mmAq) Evaluation Example 1 of invention 0.30 1.80 2.25 1.50 9.3 266 O Example 2 of invention 0.30 1.47 1.37 1.17 10.8 249 O Example 3 of invention 0.25 1.47 1.49 1.22 11.3 238 O Example 4 of invention 0.23 1.51 1.64 1.31 11.0 233 O Example 1 of a comparison 0.43 2.54 4.45 2.11 6.5 Example of 414x comparison 2 0.15 1.27 1.25 1.12 13.9 452 Example 3 of x comparison 0.303.00 7.29 2.70 6.0 368 Example 4 of x comparison 0.30 1.27 0.94 0.97 12.0 425 Example 5 of x comparison 0.30 3.5010.24 3.20 5.2 371 Inside dimension omits the inside dimension of 11h between cell walls, filter surface area omits the filter surface area per unit volume, respectively, and the x (notes) table 1 shows the cross section of 11g by which the cross section is surrounded with a cell wall.
[0032] From Table 1, cell wall thickness 11c the examples 1-4 of invention 0.1-0.3mm, The inside dimension of 11h between 1.3mm 2 or more and cell walls Moreover, 1.15mm or more, [the cross section of 11g by which cel pitch 11i is surrounded with 1.4-3mm and a cell wall] Since it is three or more 10cm2/cm preferably, the filter surface area per unit volume is known by 7cm2/cm3 and that differential pressure serves as the honeycomb structure object 11 with little [it is small and] pressure loss.
[0033] On the other hand, for the example 1 of a comparison, the cross section of 11g surrounded with a cell wall is 2 1.3mm. Although inside dimension 11i between the above or a cell wall is 1.15mm or more, since cell wall thickness is over 0.3mm, the filter surface area per unit volume is less than three 7cm2/cm, and it turns out that differential pressure is large and pressure loss is large. For the examples 2 and 4 of a comparison, the cross section of 11g surrounded with a cell wall although the filter surface areas per unit volume are three or more 7cm2/cm is 2 1.3mm. The inside dimension of 11h between the following or a cell wall is less than 1.15mm, and cel pitch 11i is less than 1.4, and it turns out that differential pressure is large and pressure loss is large. For the example 3 of a comparison, the cross section of 11g surrounded with a cell wall is 2 1.3mm. Although inside dimension 11i between the above or a cell wall is 1.15mm or more, the filter surface area per unit volume is less than three 7cm2/cm, and it turns out that differential pressure is large and pressure loss is large. For the example 5 of a comparison, the cross section of 11g surrounded with a cell wall is 2 1.3mm. Although inside dimension 11i between the above or a cell wall is 1.15mm or more, a cel pitch exceeds 3mm, and since the filter surface area per unit volume is less than three 7cm2/cm, it turns out that differential pressure is large and pressure loss is large.
[0034] (Catalyst support) The honeycomb structure object 11 of the examples 1-4 of invention supports a catalyst in cell wall 11b and pore if needed. Since the carbon which carried out uptake burns at low temperature continuously by the chemical reaction with NO2 formed of the catalytic reaction of NOx in an exhaust gas component when a platinum metal catalyst is supported on the honeycomb structure object 11, combustion temperature can be reproduced continuously, without carrying out the erosion of the honeycomb structure object by making it fall compared with the case where it is made to burn by the electric heater, a burner, etc.
[0035]
[Effect of the Invention] Above, according to the honeycomb structure object of this invention as explanation in a detail, while carrying out uptake of the particle which structure is not complicated, and it becomes easy to manufacture it, and is contained in exhaust gas efficient, pressure loss can be made low.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view of a honeycomb structure object.
[Drawing 2] It is the cross section of an example of the exhaust gas purification filter 10 using the honeycomb structure object of drawing 1 .
[Drawing 3] The partial section of the Plastic solid with which (a) has honeycomb structure, and (b) are the important section sectional views of an extrusion molding die.
[Description of Notations]
10a: Inflow
10b: Outflow
11: Honeycomb structure object
11a: Peripheral wall
11b: Cell wall
11c: Cel
11d: Inflow side edge side
11e: Outflow side edge side
11f: Inflow side edge side
11g: The cross section surrounded with a cell wall
11h: Inside dimension between cell walls
11i: Cel pitch
11t: Cell wall thickness
13a, 13b: Sealing agent
20: Metal mold for extrusion molding
21: Die
21a: Supply path
21b: Discharge path
22: Masking plate
23: Presser-foot frame

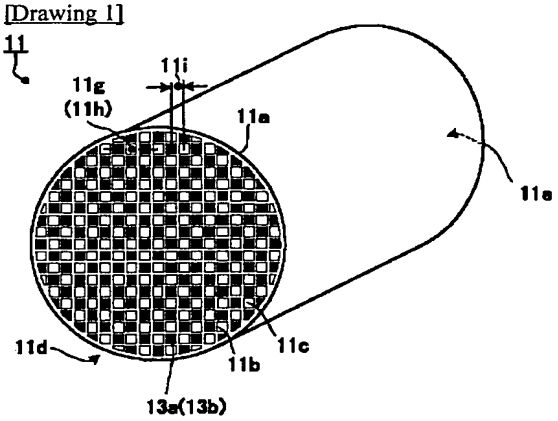
[Translation done.]

* NOTICES *

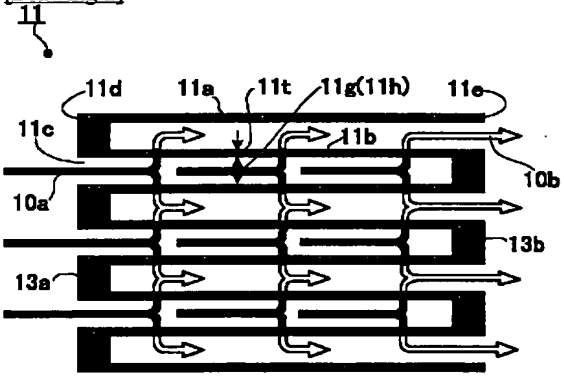
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

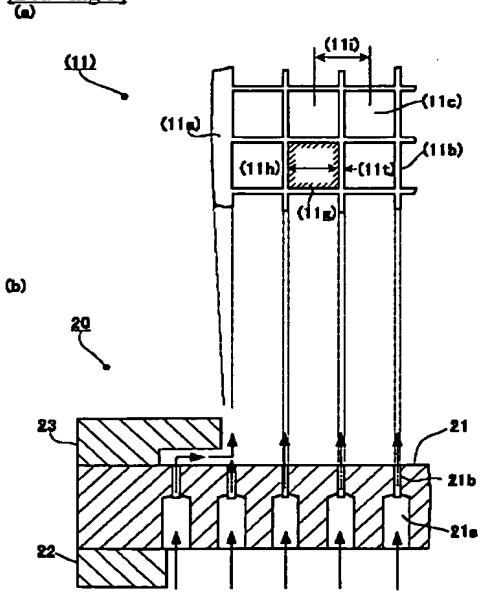
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]